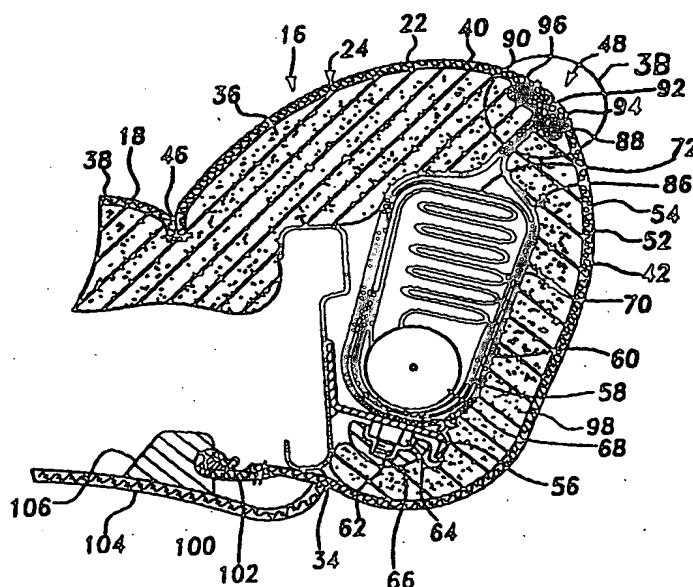




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(54) Title: SEAT MOUNTED SIDE AIR BAG WITH DEPLOYMENT FORCE CONCENTRATOR



(57) Abstract

A seat assembly having a side air bag (70) with a force concentrator (86) at least partially surrounding the air bag to concentrate and direct the force of the inflating air bag to a designed deployment seam (48) to cause the seam to rupture and allow the air bag to deploy therethrough. The force concentrator avoids the application of the air bag deployment force on the trim cover material (24) and thus reduces the influence of the trim cover on the air bag deployment and prevents stretching of the trim cover. The force concentrator forms a non-stretchable structure at least partially surrounding the air bag which carries the air bag force and directs it to the deployment seam. This produces a consistent deployment of the air bag from one seat assembly to the next and also over time as the trim cover and seat wear.

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SEAT MOUNTED SIDE AIR BAG WITH DEPLOYMENT FORCE CONCENTRATOR

BACKGROUND AND SUMMARY OF THE INVENTION

The present invention relates generally to a vehicle seat having a side air bag contained therein and in particular to such a seat with a force concentrator adjacent the air bag to concentrate the force of the inflating air bag at a designed seam in the trim cover to ensure deployment of the air bag through the seam.

5 In recent years, automobile manufacturers have directed increasing attention to providing improved side impact protection for vehicle occupants. One method of doing so is to provide an inflatable side air bag mounted to the vehicle seat and deployable between the seat occupant and the adjacent vehicle door or body structure. The side air bag (SAB) functions to dampen and distribute the impact load
10 to reduce occupant injuries.

Generally, seat mounted SAB systems fall into two different categories, known as class A and class B. A class A side air bag deploys from a visible, discrete door on the outboard side of the seat back or seat cushion bolster. A class B side air bag is stowed beneath the seat trim cover and is designed to deploy through the trim
15 cover. An advantage of the class A side air bag, is that deployment of the air bag through a door uses technology that has already been developed for frontal air bags in steering wheels and instrument panels. The technology for providing consistent and repeatable deployment of the air bag through the door is well developed. A disadvantage of a class A side air bag is that the air bag location is generally limited
20 to the side of the seat so that the visible door is not a part of the seating surface engaged by a seat occupant. If it is desired for the air bag to deploy through the front corner of the seat back, such as the location of a bolster seam, a class A side air bag cannot be used. Rather, a class B side air bag must be used in which the air bag is underneath the seat back trim cover, and typically beneath a foam pad,
25 where it does not adversely impact the seat comfort. However, with a class B side

air bag, there are considerably more variables involved in providing consistent air bag deployment and in meeting the desired air bag in-position timing.

The seat trim cover provides numerous variables affecting air bag deployment. The trim cover fabric type, such as cloth, leather, vinyl, etc. and combinations of these various types, all behave differently and have different tensile and tear strength. In addition, different materials of the same types, such as different cloth fabrics have different tensile strengths, tear strengths, weave, nap direction, etc. which can affect the manner in which an air bag deploys through the trim cover if the trim cover material is ruptured to deploy the air bag. Other variables introduced by the trim cover include the strength of the trim cover scrim layer or backing and the strength of the thin layer of foam that is typically laminated to the trim cover fabric

Wear of the trim cover over time and trim cover damage by cutting, puncturing, cigarette burns, etc., also introduce variables in air bag deployment. For example, a cut in the trim cover at a location other than the intended deployment can cause the trim cover to rupture at the wrong location, resulting in the air bag being out of position.

Other variations in the deployment can be introduced by the density and type of the seat foam pad, the presence or absence of a border wire embedded in the foam pad, the trim cover attachment locations and types of attachments and misalignment of the trim cover on the seat back.

To reduce or eliminate the effects of the above variables, it is proposed to deploy a class B type SAB through a seam in the trim cover due to thread failure. Variables affecting the seam include the seam type, number of stitches per unit length, thread strength, the seam arrangement, styling, welting, seam wear, ultraviolet exposure, etc. Most of these variables can be controlled in the design of the trim cover. As a result, greater deployment consistency can be achieved with deployment through a trim cover seam. However, even with designed deployment through a seam, the trim cover will introduce variations in SAB deployment.

It is an object of the present invention to design a vehicle seat having a side air bag with great air bag deployment consistency.

It is a further object of the invention to eliminate or minimize variability in air bag deployment introduced by the trim cover.

5 It is yet another object of the invention to provide a seat with a side air bag in which variability arising over time, caused by wear of and/or damage the trim cover, does not affect the air bag deployment.

To accomplish the above objects, the seat assembly of the present invention employs a force concentrator that at least partially surrounds the folded air bag and
10 concentrates, or directs, the force of the inflating air bag to the designed deployment seam to cause the thread to rupture and allow the air bag to deploy therethrough. The force concentrator also avoids the application of the air bag deployment load on the trim cover material and thus reduces the influence if the trim cover on the air bag deployment. Furthermore, the trim cover material is not stretched by the inflating air
15 bag, which may otherwise increase the air bag in-position timing. Since the trim cover material is not loaded during deployment, consistent bag deployment can be achieved with a variety of different cover materials.

The force concentrator forms a non-stretchable structure surrounding, or at least partially surrounding, the air bag which carries the force of the inflating air bag
20 and prevents the force from being applied to the trim cover. The force concentrator directs this force to the deployment seam to rupture the thread. This results in a consistent deployment of the air bag from one seat assembly to the next and removes the above factors, related to the trim cover, from the air bag deployment. In addition, the force concentrator provides for consistent deployment of the air bag
25 over time as the trim cover wears since the concentrator is concealed and not subject to the wear.

Two separate embodiments of the force concentrator are disclosed in the present invention. In one embodiment, the force concentrator is in the form of a layer of sheet material joined to the inside of the trim cover. The force concentrating
30 layer consists of panels of sheet material extending away from the deployment seam

in opposite directions. The force concentrator is made of a sheet of a substantially non-stretchable material with a tensile strength sufficient to withstand the force of the inflating air bag without tearing. One successfully tested material for the force concentrator is the nylon material used to make air bags. Other high strength sheet materials may be used as well.

In another embodiment, the force concentrator is in the form of a sleeve or pocket of sheet material which entirely surrounds the air bag module. The sleeve extends from the module to the deployment seam in the trim cover where the two ends of the sheet material forming the sleeve are sewn into the trim cover on opposite sides of the deployment seam. The deploying air bag is contained within the sleeve until it ruptures the deployment seam. Again, the sleeve is made of a non-stretchable material having a tensile strength sufficient to withstand the force of the inflating air bag without tearing. Air bag material can be used in this embodiment as well.

Further objects, features and advantages of the invention will become apparent from a consideration of the following description and the appended claims when taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a vehicle seat assembly having a seat mounted SAB according to the present invention;

FIG. 2 is a sectional view of the seat back as seen from substantially the line 2-2 of FIG. 1 illustrating a first embodiment of the force concentrator of the present invention;

FIG. 2A is a sectional view similar to FIG. 2 showing a variation of the embodiment of FIG. 2;

FIG. 3 is a sectional view as seen from substantially line 2-2 of FIG. 1 illustrating a second embodiment of the force concentrator of the present invention;

FIG. 3A is a perspective view of the sleeve forming the force concentrator; and
FIG. 3B is an enlargement of the circled area labeled 3B in FIG. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A seat assembly according to the present invention containing a side air bag
5 (SAB) with the force concentrator of the present invention is shown in FIG. 1 and
designated generally at 10. Seat assembly 10 includes a lower, generally horizontal,
cushion assembly 12 forming a horizontal seating surface 14. A seat back cushion
assembly 16 extends generally upwardly at the rear end of the lower cushion
assembly 12. The seat back cushion assembly 16 forms an upright front seating
10 surface 18 against which a seat occupant rests their torso. The lower cushion
assembly has left and right side bolsters 20 and the seat back cushion assembly has
left and right side bolsters 22. Both the lower cushion assembly 12 and the seat
back cushion assembly 16 can be used to mount a SAB to provide additional
occupant protection. The invention will be described below in the connection with
15 the SAB mounted to the seat back cushion assembly.

The seat back cushion assembly 16 includes a trim cover 24 which is made
of a plurality of pieces of a sheet material joined together at seams. Most notably,
the trim cover includes a bolster seam 48 at the corner of the bolster as well as a
side seam 28. The number and locations of the seams is determined partially by
20 functional considerations to develop a tight, form fitting trim cover and also by
stylistic considerations. Any appropriately located seam can be used for deployment
of an SAB.

With reference to FIG. 2, one embodiment of the seat back and the force
concentrator is shown in greater detail. The seat back cushion assembly 16
25 includes a frame 34 that provides the structural support for the cushion assembly.
The frame 34 supports a pad 36 such as a urethane foam pad, rubberized hair pad
etc. The pad is in turn covered with a trim cover 24. The portion of the trim cover
24 shown in FIG. 2 is constructed of four separate pieces of sheet material 38, 40,

42 and 44. These pieces are joined together by seams 46, 48 and 50. The seams are shown and described in the specification as being sewn with a thread. The specification is not limited to such a seam structure but includes other joining processes, such as-but not limited to, staples, heat fusion, ultrasonic welding, adhesives, etc. The particular method of forming the seam is not critical to the present invention. As will be explained below, it is the strength of the seam that is important to the invention.

Seam 48 in FIG. 2 is the bolster seam at the corner of the side bolster 22. The sheet material of the trim cover 24 has multiple layers. An outer layer 52 is made of a flexible sheet material such as woven or knit fabric, leather, vinyl or other similar material and provides a finished appearance to the seat assembly. A thin foam sheet 54 (FIG. 3B) is typically laminated to the inner surface of the fabric layer 52. In addition, other backing materials may also be laminated or joined to the foam.

The trim cover is attached to the pad 36 at the seam 46 by a tie down 49. Tie down 49 consists of a hook and loop fastener having a loop tape 51 sewn on the inside of the seam 46 and a hook strip 55 joined to the pad 36 at the base of a trench. Such a tie down is common in seat covers. Other tie downs using wires, hog rings, clips, bungy cords, flipper tabs, etc. can be used as well. Any of a variety of different tie down structures can be used if they meet the strength requirements outlined below. The trim cover may also be attached at the rear of the seat back to the frame 34 or pad by a tie down 53. The rear tie down is typically not needed for proper functioning of the air bag. While the front tie down is needed more often, there are situations in which the front tie down may not be needed either, such as air bag deployment through a side seam. In such a case, the air bag load is lateral instead of forward.

A mounting bracket 56 is attached to the frame 34 and is used to mount the side air bag module 58. The air bag module 58 includes a housing 60 with one or more threaded studs 62 that pass through apertures (not shown) in the bracket 56 and are attached thereto by nuts 64.

The module 58 further includes a folded air bag 70 and an inflator 68 that provides gas for inflating the air bag 70. A thin sheet 72 covers the folded air bag and holds the air bag in place during shipping and handling of the module. The sheet 72 is designed to rupture during deployment of the air bag without affecting the air bag deployment. The illustrated air bag module 58 is only exemplary of the many modules that could be used. The specific structure and components of the module illustrated do not form the present invention other than the folded, inflatable air bag. The bolster seam 48 is the seam through which the inflated air bag is designed to deploy. To assist the air bag in penetrating through the pad 36, the pad may be formed with a slot 74, or several spaced slots, between the air bag and the deployment seam to locally weaken the pad and encourage air bag deployment through of the foam, toward the seam 48. Depending on the location of the deployment seam, it may be possible and preferred to position the air bag directly behind the trim cover without any pad covering the air bag. This would likely be the case where a side seam is used to deploy the air bag.

As the air bag inflates, it rapidly increases in volume and pushes outward on the foam pad and trim cover 24. This will cause stretching of the trim cover until either the trim cover itself or one of the seams in the trim cover fails, enabling the air bag to penetrate through the trim cover. Optionally, the trim cover may detach from the foam pad or frame at the tie downs 49 and 53, resulting in a condition referred to as "ballooning" where the inflated air bag is retained inside the trim cover. To avoid ballooning, the attachment of the trim cover to the foam pad at the tie downs must be strong enough to avoid detachment caused by the inflating air bag. A tie down at seam 46 is most often needed when the bolster seam is used by the air bag. If a side seam 28 is used for air bag deployment, a tie down at seam 46 may not be needed for proper function of the air bag.

To avoid stretching and tearing of the trim cover, the force concentrator of the present invention is used to concentrate the force on the seam 48. This avoids application of the inflation force to the trim cover itself and eliminates variability in deployment caused by the trim cover. The force concentrator includes two panels

of sheet material 76 and 78. The panel 76 is joined to the trim cover at the seam 50 and extends around the module to the deployment seam 48 where it is sewn into that seam by the seam thread 80. The other panel 78 is joined to the trim cover at the seam 46 and extends from the seam 46 to the deployment seam 48 where it is also
5 joined into the seam by the seam thread 80. The two panels 76 and 78 are made of a substantially non-stretchable material having a tensile strength sufficient to withstand the force of the inflating air bag without tearing. Examples of successfully used materials include 420 and 630 denier nylon air bag fabric. Other high strength sheet materials may be used as well.

10 As the air bag 70 inflates and increases in size, the panels 76 and 78 are loaded in tension but do not stretch and do not tear. This avoids loading of the trim cover in tension and stretching of the cover which could result in rupture of the trim cover. The seam 48 is constructed in a manner that the seam is substantially weaker than either of the panels 76 and 78. As a result, the seam will fail before the
15 force concentrator panels fail. Since the two panels 76 and 78 are sewn into the seam 48, as the panels are loaded from the expanding air bag, the seam thread 80 is pulled and eventually fails. This allows the air bag to deploy through the ruptured seam. While there are variables that affect the seam strength, most of these are related to the seam design and thread type. Once a seam design and thread is
20 chosen, there is little variation in seam strength from one seat assembly to the next. The thread strength is fairly uniform from one lot to the next, especially compared to the variability in fabric strength. Stitch type and the number of stitches per unit length are also more uniformly controlled than the fabric strength. As a result, once deployment variables due to the trim cover have been eliminated, deployment
25 through the seam is fairly consistent.

The panels 76 and 78 function to concentrate the air bag deployment force on the seam 48. While the panels 76 and 78 are shown attached to the trim cover solely by the seams 46, 48 and 50, it is possible to incorporate the concentrator panels into the trim cover material by laminating the concentrator panels to the trim
30 cover material in addition to sewing the panels at the various seams. With the force

concentrator laminated or otherwise joined to the trim cover material, the "seam" may be formed as a weakened zone in the trim cover. It is not limited to a joint between two separate trim cover pieces. If the weakened zone is aligned with a break in force concentrator and the force concentrator is joined to the trim cover on opposite sides of the weakened zone, then the inflation force of the air bag will be applied to the 5 weakened zone of the trim cover.

While two panels 76, 78 have been shown, one on each side of seam 48, it may be possible to achieve the same function with a single panel on only one side of the deployment seam. Such a configuration will work if the air bag is located in 10 such that it would only rupture the trim cover on one side of the seam. By placing a force concentrator on that side, the force is directed to the seam to induce its failure. It must be verified that the addition of the concentrator does not induce trim cover failure elsewhere.

With reference to FIG. 2A an alternative embodiment of the force concentrator 15 of the present invention is shown and described. In FIG. 2A, the side air bag 70 is designed to deploy through a side seam 28 instead of the bolster seam 26. In such a configuration, it may be difficult to prevent the air bag from deploying through the bolster seam 26 which is located relatively close to the deployment seam 28. The force concentrator of the present invention is used to protect the seam 26 by having 20 a panel 78 extend from the deployment seam 28 all the way to the seam 46 and the tie down 49. The panel 78 is not attached to the seam 26. In order to provide the desired fit, the force concentrator panel 78 may be made from multiple pieces joined together by a seam 79 which generally parallels the trim cover bolster seam 26. The seam 79 is provided to shape the force concentrator panel 78 to the contour of the 25 foam pad 36 to produce the desired fit and finish and is designed to withstand the air bag inflation loads. Since the force concentrator panel 78 extends from the deployment seam 28 to the seam 46 and tie down 49, the inflation force of the air bag is not applied to the trim cover seam 26, thereby protecting the seam 26 and preventing unintended deployment of the air bag through that seam.

With reference to FIG. 3 and 3A, another embodiment of the invention is shown. Common elements with the embodiment shown in FIG. 2 have been assigned the same reference numerals. In this embodiment, the force concentrator is in the form of a sleeve or pocket 86 which surrounds the air bag module 58. The sleeve is of a tubular construction which is open at one or both of the top and bottom 5 87, 89 of the sleeve 86. The sleeve is made from two pieces 83 and 85 of sheet material 91. The sleeve 86 is wrapped around the module and extends forward through the foam in front of the air bag 70. The ends 88 and 90 of the sheet material pieces 83 and 85 are joined into the trim cover on opposite sides of the seam 48. 10 The seam 48 is a French seam having a first thread 92 which joins the trim cover members 40 and 42 to one another. A second thread 94 is sewn through both the end 88 of the sleeve material piece 83 and the trim cover member 42, joining the sleeve end to the trim cover. Likewise, a third thread 96 joins the end 90 of the sleeve material piece 85 to the trim cover member 40 on the other side of the seam. 15 A stripe of perforated tape 95 (FIG. 3B) is also sewn in the seam by the thread, 94 and 96. This tape is commonly provided for cosmetic reasons to avoid see-through of the seams. The tape is perforated at 97 along the seam to facilitate deployment of the air bag through the tape. Following attachment of the two pieces 83 and 85 to the seam 48, the two pieces are then joined together at their opposite ends with 20 the seam 99. The air bag module is placed within the sleeve and the mounting studs of the module extend through apertures 93 in the sleeve. While a French seam has been shown for attachment of the sleeve, a typical joint seam, such as the seam 48 shown in FIG. 2, could be used as well to attach the sleeve to the trim cover.

When the air bag 70 is inflated, it extends forward, between the two layers of 25 the sleeve, toward the seam 48. As the air bag inflates, the sleeve material is loaded in tension. This tension pulls on the seam 48 until the seam thread 92 fails. By containing the inflating air bag within the sleeve 86, the pad 36 and the trim cover 24 are not loaded in tension by the inflating air bag. Rather, the sleeve 86 concentrates or directs the force of the inflating air bag directly on the thread 92 of 30 seam 48.

The cushion assembly 16 is assembled by first sewing the sleeve 86 into the trim cover. As the trim cover is being applied over the seat back frame and pad, the inflator module is positioned within the sleeve 86 with the module studs 62 projecting rearward through apertures 93 in the sleeve. A foam pad 98 is placed on the side
5 of the module to provide padding at the side of the seat back assembly. The trim cover is then wrapped over the pad 98 and attached to the seat back structure such as wire 100 by a J-clip or other fastener 102. The rear of the seat back is closed by a hard panel 104 which is also clipped to the wire 100 by mounting flanges 106. Hard back panels of this type are known in the vehicle seating art and do not form
10 a part of the present invention. The seat back could be closed out with a fabric panel and zippers, Velcro®, or other fasteners instead of a hard panel 104.

In this and the previous embodiment, the force concentrator is joined to the trim cover by sewing. The invention is not limited to a sewn attachment of the force concentrator to the trim cover. Other joining methods can be used such as, but not
15 limited to, adhesives, hook and loop fasteners, etc.

The seat assembly of the present invention provides a force concentrator to concentrate the force of an inflating air bag to a specific location in the trim cover, typically a seam. This ensures that the trim cover fails at the seam as opposed to another, unintended, location. As a result, more consistent air bag deployment is
20 achieved.

It is to be understood that the invention is not limited to the exact construction illustrated and described above, but that various changes and modifications may be made without departing from the spirit and scope of the invention as defined in the following claims.

WE CLAIM

1. A cushion assembly for a vehicle seat assembly comprising:
 - a pad;
 - a frame supporting the pad;
 - 5 a trim cover at least partially surrounding the pad and frame, the trim cover having at least one seam therein and being made of a material having at least an outer layer;
 - the trim cover being attached to one of the pad and frame at spaced trim cover tie downs;
 - 10 an inflatable air bag and inflator mounted to the frame and at least partially covered by the pad and trim cover, the air bag, when inflated projecting through the pad and trim cover;
 - one seam of the trim cover being aligned generally with the air bag for the air bag to deploy through the trim cover by rupturing the one seam; and
 - 15 a force concentrating layer of a first panel of flexible sheet material joined to the trim cover inside the trim cover outer layer at one side of the one seam and extending from the one seam between the trim cover outer layer and the pad overlying the airbag to at least partially surround the air bag and the first panel being coupled to an adjacent trim cover tie down, the first panel being made of a material
 - 20 having a tensile strength sufficient to withstand the force of the inflating air bag without tearing whereby the force of the inflating air bag is carried by the force concentrating layer and concentrated on the one seam to rupture the one seam to enable the air bag to deploy through the trim cover.
2. The cushion assembly of claim 1 wherein the force concentrating layer
 - 25 further comprises a second panel of sheet material joined to the opposite side of the one seam and extending from the one seam in the opposite direction between the trim cover outer layer and the pad overlying the airbag to further surround the air bag, the second panel being coupled to an adjacent trim cover tie down.

3. The cushion assembly of claim 1 or 2 wherein the sheet material of the force concentrating layer is a woven nylon fabric.

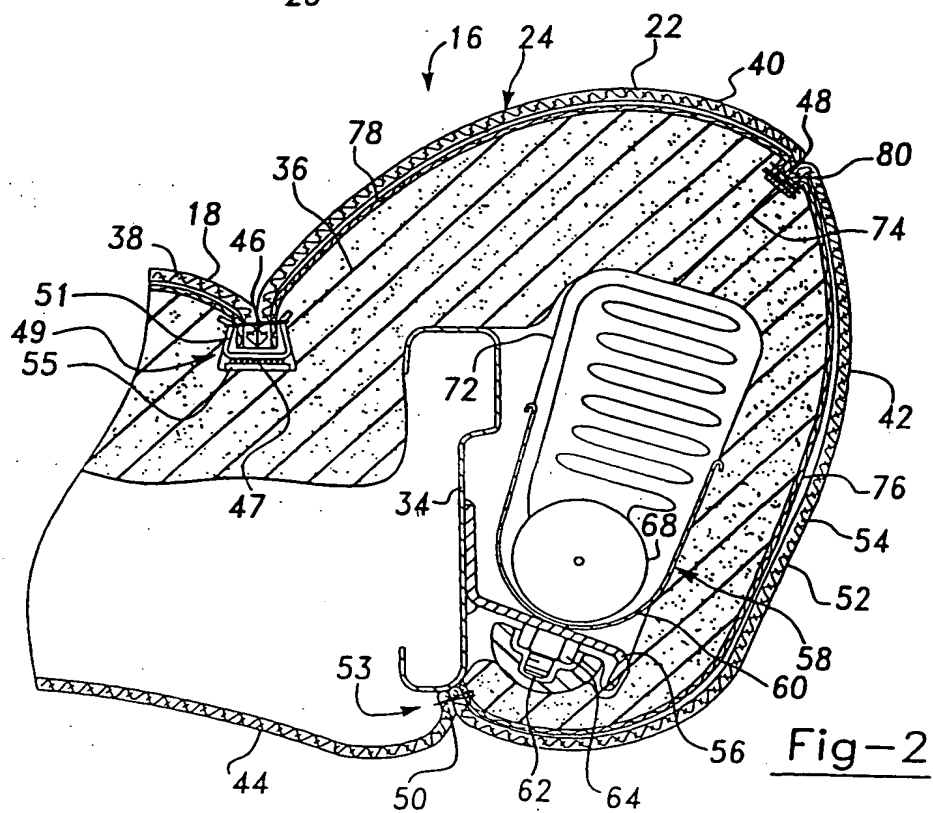
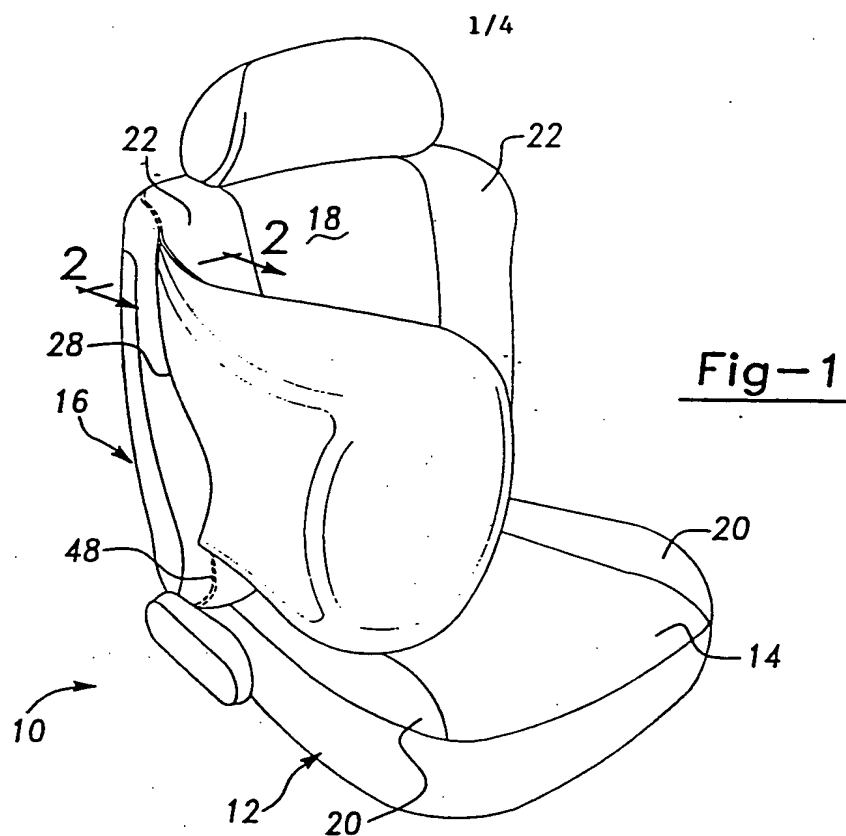
4. The cushion assembly of claim 1 or 2 wherein the sheet material of the force concentrating layer is an air bag fabric.

5. The cushion assembly according to any one of claims 1 through 4 wherein the one seam of the trim cover is a sewn seam having a thread and the force concentrating layer is sewn into the seam by the seam thread.

6. The cushion assembly according to any one of claims 1 through 5 wherein the sheet material of the force concentrating layer is laminated to the trim
10 cover material.

7. The cushion assembly according to any one of claims 1 through 6 wherein the one seam of the trim cover is a french seam having a seam thread joining two separate pieces of the trim cover together, a second thread attaching the first panel of the force concentrating layer to the trim cover on one side of the seam
15 thread and a third thread attaching the second panel of the force concentrating layer to the trim cover on the opposite side of the seam thread.

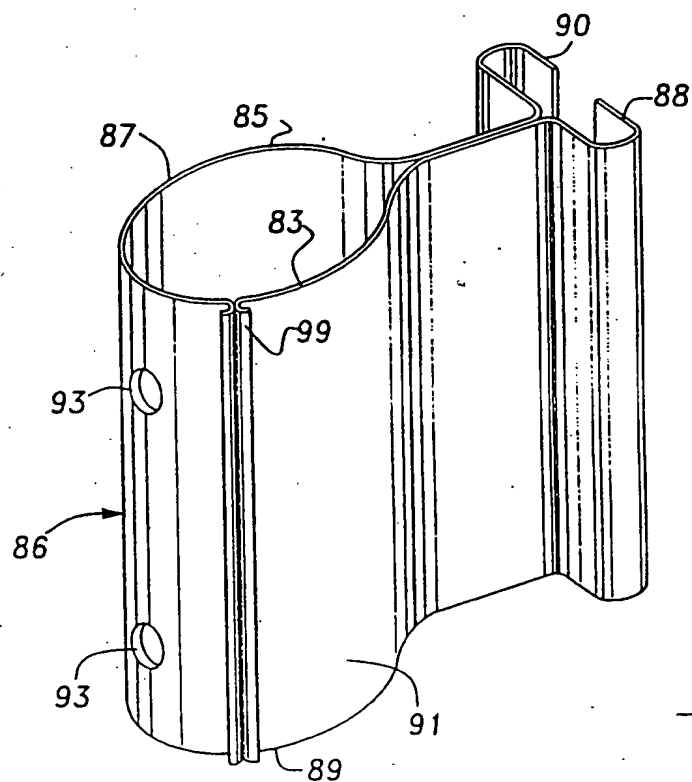
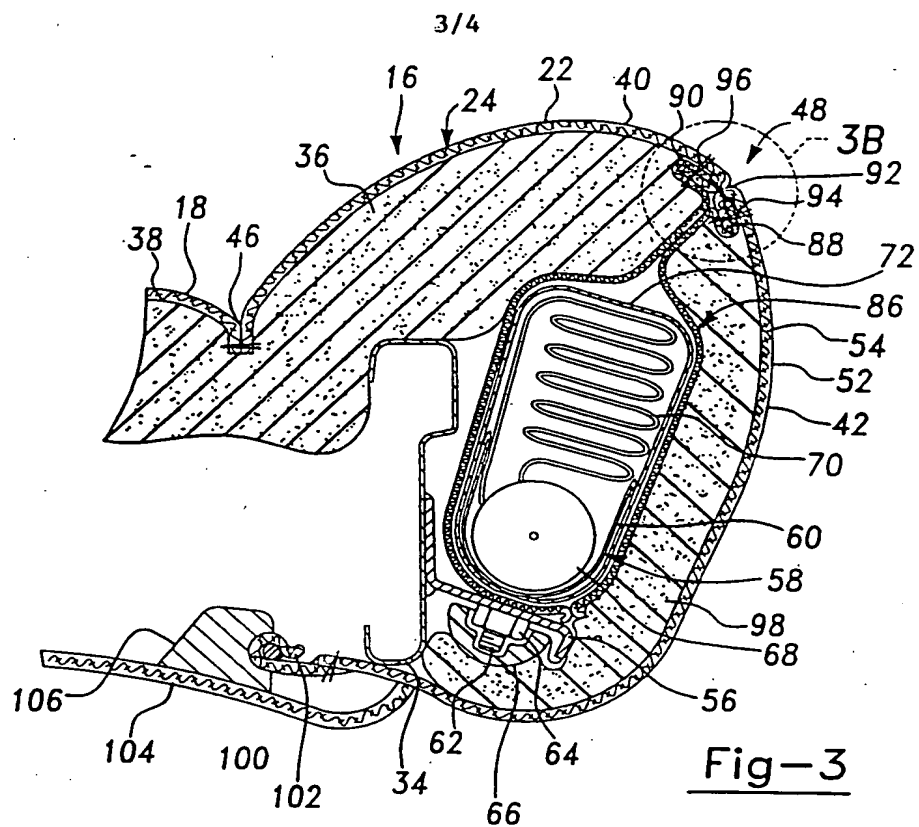
8. A cushion assembly for a vehicle seat assembly comprising:
a pad;
a frame supporting the pad;
a trim cover at least partially surrounding the pad and frame, the trim
5 cover having at least one seam therein and being made of a material having at least
an outer layer;
an inflatable air bag and an inflator mounted to the frame, the air bag
being at least partially covered by the pad and trim cover, the air bag, when inflated
projecting through the pad and trim cover;
10 one seam of the trim cover being aligned with the air bag for the air bag
to deploy through the trim cover by rupturing the one seam; and
a generally tubular force concentrating sleeve circumscribing only the
air bag and the inflator, the sleeve being made of a flexible sheet of material having
a tensile strength sufficient to withstand the force of the inflating air bag without
15 tearing; the sheet being wrapped around the air bag and inflator and the sheet
having opposite ends which are brought together and joined to the trim cover on
opposite sides of the one seam whereby the force of the inflating air bag is
concentrated on the one seam to rupture the one seam to enable the air bag to
deploy through the trim cover.
- 20 9. The cushion assembly according to claim 8 wherein the airbag and
inflator are part of a integrated air bag module mounted to the frame and the force
concentrating sleeve circumscribes the module and passes between the module and
the frame.
10. The cushion assembly according to claim 8 or 9 wherein the sheet
25 material of the force concentrating sleeve is a woven nylon fabric.
11. The cushion assembly according to any one of claims 8 through 10
wherein the force concentrating sleeve is made of an air bag fabric.



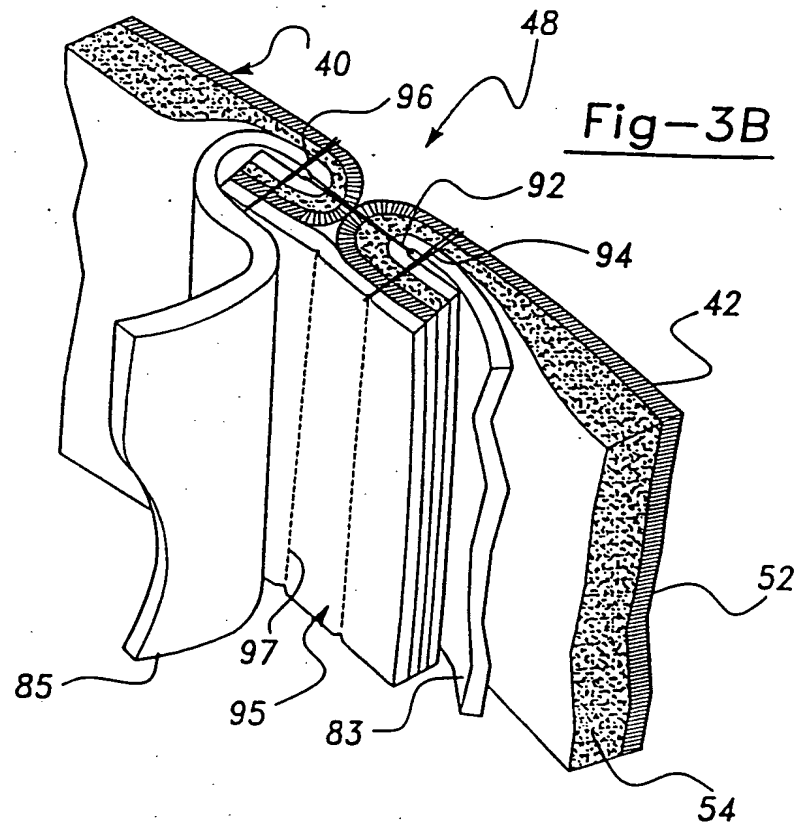
12. The cushion assembly according to any one of claims 8 through 11 wherein the one seam of the trim cover is a sewn seam having a thread and the ends of the force concentrating layer sleeve are sewn into the seam by the seam thread.

5 13. The cushion assembly according to any one of claims 8 through 12 wherein the one seam of the trim cover is a french seam having a seam thread joining two separate pieces of the trim cover together, a second thread attaching one sleeve end to the trim cover on one side of the seam thread and a third thread attaching the other sleeve end to the trim cover on the opposite side of the seam thread.

10 14. The cushion assembly according to any one of claims 8 through 13 wherein the tubular sleeve has a top and a bottom and at least one of the top and bottom is open.



4/4



INTERNATIONAL SEARCH REPORT

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PCT/US 98/03777

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B60R21/20 B60R21/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B60R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 293 355 A (ALLIED SIGNAL DEUTSCHLAND GMBH) 27 March 1996 see page 10, line 21 - page 12, line 20; figures 1-5 see page 12, paragraph 4 - page 13, paragraph 1; figure 6A see page 13, paragraph 3; figure 7	8,14
Y	---	9-11
Y	US 5 498 030 A (HILL ET AL.) 12 March 1996 see column 5, line 65 - column 7, line 8; figures 7-10 --- -/--	9-11

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *Z* document member of the same patent family

Date of the actual completion of the international search

27 May 1998

Date of mailing of the international search report

12.06.98

Name and mailing address of the ISA

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Authorized officer

Dubois, B

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 98/03777

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 097, no. 002, 28 February 1997 & JP 08 258660 A (IKEDA BUSSAN CO LTD), 8 October 1996; see abstract; figures 1-3	8,9
A	---	12
A	WO 97 04994 A (TOYO TIRE & RUBBER CO., LTD.) 13 February 1997 see figures 16,17	1
P,A	& EP 0 782 944 A (TOYO TIRE & RUBBER CO., LTD.) see column 10, line 10 - line 32; figures 16,17	
P,X	--- EP 0 788 940 A (TOYOTA JIDOSHA KK) 13 August 1997 see column 12, line 43 - column 14, line 18; figures 1-4	1
P,X	--- WO 97 42062 A (ALLIED SIGNAL INC.) 13 November 1997 see page 5, line 31 - page 11, line 2; figures 2-8 -----	1,3-6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 98/03777

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-7

Seat integrated airbag assembly with deployment force concentration layer adjacent to the seat trim cover inside the trim cover outer layer.

2. Claims: 8-14

Seat integrated airbag assembly with deployment force concentration sleeve circumscribing only the airbag and the inflator.

INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern. Application No

PCT/US 98/03777

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
GB 2293355	A	27-03-1996	DE 77	05-03-1998
			EP 077	11-06-1997
			WO 9607563	14-03-1996
US 5498030	A	12-03-1996	WO 9630233	03-10-1996
WO 9704994	A	13-02-1997	JP 9039711	10-02-1997
			JP 9071212	18-03-1997
			EP 0782944	09-07-1997
			JP 9254735	30-09-1997
EP 788940	A	13-08-1997	JP 9076868	25-03-1997
			JP 9295547	18-11-1997
			CA 2185296	19-03-1997
WO 9742062	A	13-11-1997	NONE	